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*MECHANICAL CHARACTERIZATION AND FRACTURE BEHAVIOR OF MAGNESIUM ZK60A ALLOY
(UNS M16600)*

by

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Abstract

This research work focuses on studying the mechanical and fracture behavior of one of magnesium ZK60A (UNS M16600) extrusion. The material has many industrial applications and its characteristic should be measured for proper component or system design. Several tests were conducted following the standard procedures to determine the mechanical characteristics of the material. In addition, the fracture toughness of the material has been measured using the fracture toughness-thickness curve. A stress intensity factor K was used as a fracture parameter to determine the plane strain fracture toughness K_{IC} of ZK60A magnesium alloy using a single edge notch bend (SENB) specimen in accordance to ASTM E399 testing method. A sharp fatigue pre-crack was initiated, then the specimen has been loaded till maximum load and beyond. The fracture toughness K_C values obtained for different thicknesses showed that K_C value decreased with increasing specimen thickness. The highest K_C value obtained was 24.7 MPa \sqrt{m} for 4 mm thickness specimen. The value of K_C became relatively constant at about 20.6 MPa \sqrt{m} when the specimen thickness exceeds to 12 mm. This value was then considered as the plane strain fracture toughness K_{IC} of ZK60A magnesium alloy. Finally, the stable crack growth (SCG) behavior through the alloy was investigated to determine the initiation P_i loads, the instability P_{max} loads and the range of SCG. The maximum value of P_{max}/P_i was recorded (3.86) for $a_0/W=0.5$ and crack angle of 45°. Also, a range of stable crack growth at the surface from 0.5 to 2 mm was observed for mode I and from 2 to 5 mm for mixed mode. Different fracture samples were employed to study mode I and mixed mode (I and II) fracture performance through SENB specimen. Several characterization techniques were utilized, such as SEM, to investigate the fracture surface topography of different regions during the stable crack growth.

Keywords: Mechanical properties, Tensile tests, Charpy impact tests, Stress intensity factor,

Fracture toughness, Stable crack growth, and Scanning electron microscopy.